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REMARKS

Claim 1 has been amended to more clearly point out the subject matter that Applicants regard as their invention. As such, claims 1-10 remain active in this case.

The Examiner rejected claims 1, 7 and 10 under 35 U.S.C. §103(a) as being unpatentable over Itoh et al. in view of either Basiulis or Nelson. Applicants' invention as recited in amended claim 1 is for a superconducting magnet system in which a cryocooler is in contact with the cryogenic shield, but not a cryogen vessel containing a cryogenic liquid, to provide refrigeration directly to the cryogenic shield and therefore the superconducting magnet and indirectly to the liquid cryogen within the cryogen vessel through heat transfer effected within a heat pipe that is located between the cryogenic shield and the liquid cryogen. As a result, when the cryocooler is operating, boil-off of the liquid cryogen is prevented by subcooling the liquid cryogen within the cryogen vessel through the heat pipe and when the cryocooler is not operating, the heat transfer from the cryogenic shield to the heat pipe will evaporate the liquid cryogen within the cryogen vessel to provide shield cooling and therefore, the cooling of the superconducting magnet. As such, the present invention provides an auxiliary source of refrigeration from a cryogen vessel that contains a liquid cryogen such that upon failure of the cryocooler, the superconducting magnet can still operate from the refrigeration that is stored within the cryogen vessel.

By way of background and also as specifically recited in claim 1, a superconducting magnet is cooled by the cryocooler through a heat shield. A heat shield can consist of a plurality of layers, the innermost layer surrounds the superconducting magnet. Successive outer layers of shields are also cooled by the cryocooler at successively warmer temperatures to intercept heat leakage through the container that would otherwise heat the superconducting magnet. In this regard, with respect to the superconducting magnet itself, the innermost heat shield can be in contact with the superconducting magnet or can contain a liquid cryogen that is maintained as a liquid through the cryocooler.

Applicants disagree with the Examiner that Itoh et al. discloses Applicants basic inventive concept, namely, a superconducting magnet system with a cryocooler 7 which cools shield 2 and a cryogen tank 5 cooling a heat pipe 30. In this regard, with reference to Fig. 5, what is disclosed is a cryocooler 7, that is

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multistage, as contemplated in the present invention. In one stage, an outer shield, unlabeled, is cooled by the cryocooler. Another stage of the cryocooler is in contact with a cryogenic liquid. The cryocooler 7 maintains the cryogenic liquid 5 as a liquid within a tank. Heat from the superconducting magnet is transferred through a heat pipe 30 to the cryogenic tank and therefore the cryogenic liquid 5 causing it to vaporize. The cryogenic vapor is recondensed by the cryocooler stage in the tank to maintain the cryogen as a liquid. A cooling storage tank 14 is connected to the container for cryogenic liquid 5 by way of a pipe 15.

Consequently, although the cryocooler in Itoh et al. is in contact with the cryogenic shield, assuming that the vessel containing cryogenic liquid 5 is a cryogen vessel, unlike the present invention, the cryocooler is in contact with the cryogen vessel and directly provides refrigeration to the cryogenic liquid through heat transfer through the vapor within the tank. Furthermore, the cryocooler 7, also unlike the present invention is providing refrigeration directly to the liquid cryogen rather than through a heat transfer affected within a heat pipe between the cryogenic shield and the liquid cryogen. It is to be noted that given that heat pipe 30 of Itoh et al. would contain a wicking material, whether or not Basiulis or Nelson discloses a heat pipe with a wicking material, the Examiner's rejecting combination would not meet the term of Applicants' invention as presently claimed in amended claim 1. In order to meet the terms of Applicants' invention, the terminal stage of cryogenic refrigerator 7 would have to be in contact with magnet 1 and not with the tank holding cryogenic liquid 5. Consequently, as presently claimed, it would not be rendered obvious by the Examiner's rejecting combination.

Since claim 1 is in allowable form, Applicants submit that claims 7 and 10 are likewise in allowable form. In this regard, in addition to the mechanism described above from which the cryocooler cools a heat shield and thereby subcools a liquid cryogen through a heat pipe connected between a cryogen vessel and the heat shield, further, a bus bar, as recited in claims 7 and 8, constitutes additional means for providing refrigeration from the cryocooler to the cryogen vessel. Again, these additional means are not provided in Itoh et al. in which a stage of the cryocooler condenses vapor within the cryogenic vessel. As to claim 10, although the heat pipe in Itoh et al. is in direct heat exchange with a cryogen vessel, the heat pipe is not arranged between the heat shield and

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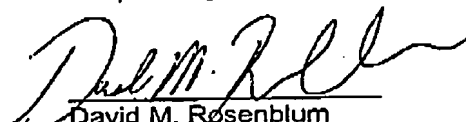
cryogenic vessel with the cryocooler not in contact with the cryogen vessel as called for in claim 10.

The Examiner additionally rejected claims 2-6, 8 and 9 under 35 U.S.C. §103(a) as being unpatentable over Itoh et al. in view of Basiulis or Nelson as applied to claims 1, 2 and 7 and further in view of Breneman. Additionally, claims 2-6, 8 and 9 were rejected under U.S.C. §103(a) as being unpatentable over Itoh et al. in view of either Basiulis or Nelson as applied to claims 1, 7 and 10 above and further in view of Lehmann et al. However, Applicants submit that such grounds of rejection are rendered moot in view of the fact that claims 2-10 all depend on claim 1, which is in allowable form.

Applicants are aware that this response is being made within the first month. Therefore, Applicants have submitted herewith a petition to extend the time to answer to the first month together with directions to charge Applicants Assignee's deposit account no. 16-2440 with the appropriate fee.

In view of the amendments to the claims and the remarks set forth above, Applicants request reconsideration of the rejection and the allowance of all presently pending claims. Since the claims are in condition for allowance, prompt and favorable action is hereby solicited.

Respectfully submitted,

  
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